

3. Empyema was rare, occurring in less than 4 per cent. of the cases.

4. Acute laryngitis was comparatively rare, occurring in but 6 out of 38 larynges examined (16 per cent.).

5. Sphenoid sinusitis was a very common complication and was found in 20 out of 22 cases examined (90 per cent.).

6. Seven out of 35 premortem blood cultures showed pneumococci. The rest were sterile with the exception of one, which showed a meningococcus.

7. The bacteria found in the organs at autopsy were varied, the *Streptococcus hemolyticus*, pneumococcus, staphylococcus, non-hemolytic streptococcus, *Bacillus influenzae* and Gram-negative cocci being found in the various cases in the order of frequently given above.

CHRONIC NON-TUBERCULOUS LUNG INFECTION.

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THE material for this paper consists of eight cases from a somewhat larger number seen during the past year in the medical clinic of the University Hospital of the State University of Iowa. Our object has been simply to review the literature and to emphasize some points in the diagnosis and treatment of this condition which so closely resembles tuberculosis and which is so frequently erroneously diagnosed as such. We do not claim any originality either in diagnosis or treatment, both of which have previously been fully described.

The recent influenza epidemic left in its wake countless cases of chronic cough, many of which are unquestionably due to tuberculosis, as is proved by the finding of acid-fast bacilli in the sputum. However, in many so diagnosed tubercle bacilli are not found and the subsequent course is unlike tuberculosis. Many of these cases are simple bronchitis, general or localized, or, to use the term recently suggested by Garvin, Lyall and Morita,¹ chronic non-tuberculous lung infection.

In 1902 and 1905 F. T. Lord² described a series of these cases under the title of chronic influenza. Since then similar cases have been reported by Riesman³ in 1913, Larabee⁴ in 1915 and more recently papers on the subject have appeared by Hammond and

¹ Am. Rev. Tuberculosis, 1917, i, 16.

² Boston Med. and Surg. Jour., 1902, cxlvii, 662; Boston Med. and Surg. Jour., 1905, clii, 537.

³ Am. Jour. Med. Sc., 1913, cxlvi, 313.

⁴ Boston Med. and Surg. Jour., 1915, clxxii, 257.

Wollman,⁵ Garvin, Lyall and Morita and J. A. Miller.⁶ The disease has been variously called "a lobular form of bronchopneumonia of long duration," "localized bronchitis," and "subacute and chronic non-tuberculous lung infection."

ETIOLOGY. *Age.* The onset may occur at any age, but seems to occur somewhat more frequently in children. G. F. Still,⁷ who has described this disease in children, says it is most frequent before the age of five, due not only to the frequency of measles and whooping-cough, which diseases it often follows, but because of a special predisposition of the bronchi of children to infection. In children there is a relatively large amount of loose connective tissue in the walls of the bronchi and alveoli, which is easily infected and permits chronic dilatation of the bloodvessels to occur with relative ease. The frequency of mouth-breathing and chronic nasal disease in children also undoubtedly increases their liability to bronchial disease. Of our 8 cases, 3 began before the age of six, 2 at thirteen and 3 at twenty. Miller's cases ranged from seven to sixty years. The majority of Riesman's cases were between ten and twenty.

Sex. The disease is more common in females. In Miller's series there were 14 females to 8 males. In Riesman's series girls predominated. Our cases were divided equally between the two sexes.

Previous Infection. The syndrome usually follows acute diseases, which affect particularly the upper respiratory tract, such as measles, whooping-cough and influenza, though in some cases it comes on insidiously.

Season. Both the onset and the exacerbations occur more frequently during the colder months, October to April, due probably to the crowding of people together in poorly ventilated and often dusty or smoky rooms and the increased tendency for respiratory disease to pass from person to person under such circumstances.

Nasal Disease. Adenoids and nasal deformities which cause mouth-breathing are important etiological factors. Chronic sinusitis is probably present to a greater or less extent in all the cases. Three of our cases had definite severe sinus diseases and in all the lung exacerbations were invariably accompanied by coryza.

Family. Miller reports 2 cases from the same family in two instances. In each instance the same organism was isolated from the 2 cases, suggesting the possibility of contagion. Two of our cases came from the same home and *Staphylococcus albus* was isolated from the sputum of each of them. The same predisposing factor, as poor ventilation, with dust or smoke, may help in increasing the family incidence.

Deformed Chest. Still mentions the frequency with which localized bronchitis may occur in rachitic chests, due to the fact that

⁵ Tr. Nat. Assn. Study and Prev. Tuberculosis, 1916, p. 171.

⁶ AM. JOUR. MED. SC., 1917, cliv, 805.

⁷ Common Disorders and Diseases of Childhood, p. 353.

portions of the lung cannot properly expand and easily become chronically infected. None of the cases here reported had any deformity of the chest whatever, but we have seen some cases in which the deformity seemed to be of etiological significance.

Bacteriology. *Bacillus influenzae* is the most frequent predominating organism in the sputum and was found in 36 per cent. of Lord's cases, but any of the common invaders of the respiratory tract may be found. In our 8 cases *Bacillus influenzae* was found to predominate in only one instance, while the *Streptococcus pyogenes* was predominant in 3 and *Staphylococcus albus* in 4. In one of the streptococcus cases a similar organism was isolated from pus found in the antrum of Highmore. Miller's cases showed *Bacillus influenzae* in 7, pneumococcus, type IV, in 10, and *Streptococcus viridans* in 4.

Out of 66 cases Lord found *Bacillus influenzae* in 44, pneumococcus in 8, *Micrococcus catarrhalis* in 5, *Bacillus mucosus capsulatus* and pseudopneumococcus in 3 each. A different organism is sometimes found to predominate at a later time, as was the case in one of our patients who had *Bacillus influenzae* at first; but two weeks later *Staphylococcus albus* was found to be the predominating organism. Lord found such a change to occur in some of his cases.

Pathology. Since this is a relatively benign process there has been very little opportunity to make postmortem examinations. None of our cases came to autopsy. Hammond and Wollman had an autopsy on one case and found "localized bronchitis and infiltration of the bronchial wall and foci of bronchopneumonia about the smaller bronchi." Lord examined, postmortem, a typical case of forty-four years' duration and found slight general bronchiectasis, with many small areas of interstitial pneumonia. It therefore seems probable that, as Miller has stated, the pathology "may consist of a localized bronchitis, with a lobular distribution, which may clear up or persist in a subacute form, offering a site predisposed to exacerbations and increased tendency to fibrosis." That the late changes are bronchiectasis and areas of interstitial pneumonia is shown by Lord's case. The tendency in some of the cases for the cough to become paroxysmal, with considerable amounts of sputum, shows there must be some dilatation of the smaller bronchi fairly early in the course of the disease. The roentgenograms often show some fibrous thickening, which occasionally pulls the heart slightly to the affected side.

SYMPTOMS AND COURSE. Chronic cough, usually most marked in the mornings, and expectoration of variable amounts of mucopurulent sputum are the outstanding features in practically all the cases. The general health is relatively little affected, but many of the cases complain of slight loss of appetite, slight loss of weight and lack of endurance. Four of our cases complained of these, but the other four claimed they were in perfect health except

for cough and expectoration. One of our cases had several frank hemorrhages, two of which consisted of as much as a pint of bright red blood. Many cases with hemoptysis have been reported in the literature. Moderate fever, night-sweats, pain in the chest, in short, any of the symptoms of tuberculosis may be present. Riesman has pointed out that subacute and chronic lung infections may be the cause of obscure long-continued fever, as some of these cases complain of no symptom referable to the chest, and it is only by making routine chest examinations and finding the typical signs that the nature of the process is suspected.

The course of the disease is marked by extreme chronicity, with a tendency to frequent exacerbations. The latter are usually accompanied by coryza, fever, increased cough and tightness in the chest, frequently pain in the affected side, and occasionally, as in one of Miller's cases, slight effusion. Some of the cases go on to complete recovery in from two to six months, but when the condition has become well established the patients go on from year to year with nothing but temporary abatements, and eventually the general health becomes more or less impaired. The prognosis is best in children.

PHYSICAL SIGNS. The site of the lesion in our 8 cases was the left lobe in 5, the right lower lobe in 1 and both lower lobes in 2. In 7 of Lord's chronic cases the right lower was affected in 2, the left lower in 1 and one or both apices in 3. Garvin, Lyall and Morita state that in 90 per cent. of the cases the lesion is in the lower half of the lungs. Inspection reveals nothing abnormal, or, at most, only slight lagging of the affected side. The typical signs are subcrepitant rales, especially after cough, in one of the lower lobes. These may be brought out by placing the patient in the inverted position, as has been emphasized by Garvin, Lyall and Morita. Over the affected area the percussion note is often somewhat impaired and the breath sounds somewhat harsh. Physical signs are frequently insignificant and occasionally entirely absent.

Three of our patients were rather pale, emaciated and "sick" looking, but all the rest were well nourished and of good color. Two had considerable incurvature of the finger nails. All had slight leukocytosis (11,000 to 12,400 per c.mm.) and three had slight anemia.

All of our cases raised mucopurulent sputum varying in amount from $\frac{1}{2}$ dram to 1 ounce daily. Two cases were not expectorating anything when admitted, but upon being placed in the inverted posture for fifteen minutes, three times a day, both began bringing up small amounts of mucopurulent sputum. The sputum in most of our cases contained the green nummular masses so often seen in influenza. Tubercle bacilli were never found in any of the sputa after repeated examinations both with and without antiformin.

The von Pirquet test was negative in the four children. Two of

the adult cases gave no general or focal reaction to the subcutaneous test. The latter test was not tried on the other two adult cases.

DIAGNOSIS. That the diagnosis is frequently missed is shown by the fact that one-half of our cases were previously diagnosed tuberculosis. Cases with chronic cough, which is not paroxysmal; purulent sputum persistently negative for acid-fast bacilli; insignificant roentgen-ray findings, with rales located in the lower half of the chest (in the absence of a heart lesion); and the general health only slightly impaired are undoubtedly cases of chronic non-tuberculous lung infection.

When the lesion is located at one or both apices the diagnosis is more difficult and tuberculosis cannot always be positively excluded even after prolonged observation. Against the latter, however, is the fact that the disease has no tendency to spread to other parts of the lung and the sputum never contains tubercle bacilli. The absence of acid-fast bacilli from purulent sputum, after careful and persistent search, can be said, for all practical purposes, to rule out tuberculosis. The general robustness of the patients in spite of the extreme chronicity of the disease and the frequent exacerbations, the negative roentgen-ray finding and negative tuberculin test are sufficient evidence to exclude tuberculosis.

In our 4 cases which were previously diagnosed tuberculosis the signs were entirely confined to the lower half of the lungs. Basal lesions in tuberculosis are rare and are always toxic. The good, general health of these patients, in relation to their rather extensive physical signs of lung involvement, made us doubt the diagnosis at once.

Subacute cases, with moderate daily rise of temperature, may at first resemble typhoid fever; but the slight leukocytosis, negative Widal and blood culture, together with the finding of the characteristic lung signs, should suggest the correct diagnosis.

Bronchiectasis can usually be excluded by the fact that the sputum is brought up in smaller amounts and not in the paroxysmal manner so characteristic of that disease. However, as mentioned before, sooner or later some of the cases probably develop slight bronchiectasis.

Sometimes the disease may be recognized at its very beginning by careful examination before discharge of all cases of influenza, acute bronchitis, measles, etc. Recently one of our patients with acute bronchitis, who had never been troubled with cough before, was about to be discharged after being free from temperature and symptoms for several days. On routine examination of the chest the left lower lobe was found to be filled with crackling rales, and the percussion note was somewhat impaired over this area.

During the six weeks since he has been reporting regularly to the out-patient clinic, and, in spite of treatment, the signs still persist, and he has now considerable cough and expectoration.

TREATMENT. As Garvin, Lyall and Morita have pointed out the essential treatment is posture. The constant hacking which these patients carry on never entirely frees the smaller bronchi from secretion and alleviates the desire to cough for only a brief period of time. Drainage can be accomplished by having the patient hang over the end of the bed or kneel on a chair, with his hands on the floor. Placing the patient in the Trendelenburg or reverse Trendelenburg position on an operating or treatment table is more comfortable for the patient, and in some cases produces better drainage. The posture should vary somewhat, depending upon which part of the lung is to be drained. It may be necessary to try several different positions before the one which accomplishes adequate drainage is determined. The experience of the patient is often valuable in making this determination. The treatments should be of sufficient length and frequency to keep the affected area fairly free from secretion. Fifteen minutes, three or four times a day, are usually necessary at first. All of our cases have received distinct benefit from this form of treatment. Patients who have been coughing more or less all day long, and even having their sleep disturbed by paroxysms of coughing, soon cough only at the time of inversion. The amount of sputum gradually becomes less and the general health rapidly improves. There may be a slight febrile reaction after the initial drainage, but after that the toxic symptoms rapidly disappear entirely. Two of our cases who were raising no sputum began to expectorate from 1 to 4 c.c. daily after postural treatment was started, thus giving us an opportunity to examine the sputum in addition to putting an end to their cough and afternoon fever. During or immediately after inversion the rales can be much more easily heard, and, in fact, may be heard only at this time.

It may be necessary to continue this inversion over long periods, a year or more, but patients soon become accustomed to it, and the benefit is so obvious that they are usually enthusiastic and can readily be persuaded to carry it on in their homes. Our patients also received inhalations of compound tincture of benzoin following the inversions. In view of the fact that the affected part of the lung may be held down by adhesions, pulmonary gymnastics in the form of blowing-bottles should benefit some of the cases. This has been tried, with considerable success, in this hospital in the department of pediatrics, where a number of these cases have occurred. In all the cases the nasal sinuses should be carefully examined and any existing disease eradicated as far as possible.

Since the exacerbations occur in the colder months it may be advisable to recommend a warm climate for the chronic cases that are refractory to treatment. Exacerbations should be avoided by living an out-of-door life and avoiding exposure to people suffering from acute colds. Irritants to the bronchial mucosa, such as tobacco smoke and dust, should also be avoided.

We used an autogenous vaccine in 2 cases, but noticed no more improvement than in similar cases which were receiving only postural treatment.

I beg to acknowledge my appreciation to Professor C. P. Howard for giving me the opportunity to study and report these cases.

CASE REPORTS.

E. S., No. 6275. White boy, aged fourteen years, entered May 19, complaining of cough and expectoration dating from measles at five. He was well nourished and there were subcrepitant rales in both lower backs as high as the angles of the scapulæ. The sputum was negative for tubercle bacilli and the cultures showed a marked predominance of the *Streptococcus pyogenes*. Afternoon temperature, 99.6° F.; leukocytes, 11,000; Wassermann, von Pirquet and roentgenograms negative; chronic empyema of antrum of Highmore. Antrum was drained and reverse Trendelenburg posture for fifteen minutes, three times a day, were given. Discharged June 20, free from cough, expectoration and temperature.

O. M., No. 6337. Male, aged twenty-two years, entered June 4, with headache, cough and temperature of 102.8°, which began the day before. Past pulmonary history negative. Lungs negative. Temperature became normal on the sixth day but continued to raise large amounts of green nummular sputum, slightly streaked with blood. At this time the left lower lobe was found to be filled with subcrepitant rales. Six weeks later, when seen in the outpatient clinic, the signs were unchanged and the sputum contained a pure culture of *Bacillus influenzae*. He is now rapidly improving on postural treatment.

E. C., No. 6274. White male, aged nineteen years, entered May 19, complaining of constant cough and expectoration dating to whooping-cough, two years ago. During the last four months he had lost ten pounds and felt weak and tired. He was pale and emaciated. The lung signs were sharply localized to the right lower lobe, where the percussion note was impaired and many subcrepitant rales were heard. The sputum showed *Streptococcus pyogenes* and no tubercle bacilli. Afternoon temperature, 99.2° F.; leukocytes, 11,000; von Pirquet and roentgen rays negative. Carried out postural treatment at home. Two months later cough and expectoration had ceased and general health was much improved.

A. De S., No. 6114. White male, aged twenty-six years, entered April 3, 1919. Had constant cough, with frequent exacerbations and variable amounts of thick, yellow sputum as long as he could remember. Color and nutrition were normal and both lower lobes filled with rales. He was raising about one ounce of sputum daily, which contained a predominance of *Staphylococcus albus*. Afternoon temperature, 99.2° F., Wassermann, von Pirquet and roent-

genograms were negative. Chronic pansinusitis. Drainage of the sinuses and postural treatment for one month resulted in marked improvement in the cough and reduction of the daily amount of sputum to $\frac{1}{2}$ c.c.

E. B., No. 5810. White girl, aged fifteen years, entered January 10, 1919. Had been coughing since measles at six. Expectorated one dram to an ounce of sputum daily. Color and nutrition normal. Both lower lobes were filled with rales brought out by coughing. Afternoon temperature, 99.6°; leukocytes, 12,200; red cells, 3,910,000; hemoglobin, 75 per cent. Sputum was green nummular type and cultures showed *Staphylococcus albus*. Wassermann and von Pirquet negative. Roentgen rays showed considerable fine radiating thickenings at the bases. Sinuses negative. After two months of postural treatment the anemia had disappeared and she had gained six and three-quarter pounds. Cough, sputum and lung signs had disappeared.

L. C., No. 4816. White female, aged fourteen years, entered June 16, 1918. Had a chronic cough since whooping-cough in July, 1917, which had become much worse since she had measles in May, 1918, since when she has expectorated about one ounce of sputum daily, perspired profusely at night and lost weight and strength. She was very pale and emaciated and there was slight clubbing of the fingers. There was impaired percussion note and numerous moist rales over the left lower lobe. The sputum contained *Streptococcus pyogenes*. Roentgen rays, von Pirquet and Wassermann negative. Afternoon temperature, 99.2°; leukocytes, 11,000. Was discharged July 25, 1918, free from cough and expectoration. She had gained six pounds; color and temperature were normal.

L. E., No. 6299. White female, aged twenty-seven years, entered May 24, 1919. Had a severe cold eight years ago, during which she had several hemoptyses, two of which were as much as a pint. Has had constant cough since. Sputum is often blood-streaked. She looked healthy and the only signs found were impaired percussion note and moist rales over the left lower lobe. She was not expectorating when admitted, but after postural treatment was begun she raised one dram daily of green nummular sputum which contained *Staphylococcus albus*, and the cough ceased except at time of inversion. Subcutaneous tuberculin test and roentgenograms were negative.

E. D., No. 6374. White boy, aged thirteen years, entered June 16, 1919. Had whooping-cough at nine and has since had cough and expectoration, with frequent exacerbations. He was pale and emaciated and running an afternoon temperature of 99.8°. The lower left lobe was filled with rales. Leukocytes, 12,000. Von Pirquet and roentgen rays negative. Sputum contained *Staphylococcus albus* in almost pure culture. Temperature and weight became normal and cough and expectoration much improved after two weeks.